How Ethanol Got Into Gasoline; Why it is Time to Remove it. – By Joe LeMay

Many will attempt to blame fuel system issues on ethanol in their gasoline. The information below is not about the issue with ethanol, but how the ethanol got into the gasoline supply. Maybe with some background, it is easy to see the reason for the addition and see that it is time for a change due to technology.

The Clean Air Act of 1970 required vehicle emission reductions. Think back to the first vehicle you experienced that had emission controls. There was a lot of effort to make a basic carbureted engine operate with reduced emissions. There were add-on systems such as air injection and exhaust gas recirculation. The vehicles did not run that well because the combustion process was attempted to be mechanically altered. That system was inherently flawed from an emissions perspective.

In 1990, there were amendments to the Clean Air Act. The amendments included the requirement to use oxygenated gasoline ("reformulated" gasoline). An oxygenated gasoline mixture allows the fuel to burn more completely and therefore produce cleaner emissions. Its use in fuel has obvious benefits for improving air quality.

With the new revisions, petroleum companies had to come up with a new way to make a cleaner-burning fuel. One option that we had until recently is MTBE. It was added beginning in 1979 as an anti-knock agent, replacing lead that had a similar use as an anti-knock agent. MTBE also is an oxygenate for gasoline. In 2002-2007, MTBE was banned due to persistent groundwater contamination from leaking storage tanks.

Methanol was another effort. For a time in California, there were 5,000 Ford Taurus FFV that would operate on an 85% methanol fuel. There were also specific gas pumps for that fuel. Some of you may have remembered those vehicles if you lived in the region. That program did not last long.

Ethanol is used as an option as both an oxygenate and as an octane booster for anti-knock properties. There are however many issues with ethanol and with production of ethanol as a replacement for portions of gasoline.

At the time when an oxygenate became part of the fuel requirement, there were fewer choices of engine control systems, fuel injection systems, and performance enhancements available in engine technology. Ethanol provided a fuel option that was beneficial. However, technology has now surpassed the ethanol option. Ethanol as a oxygenate is no longer needed. Current emission control systems produce the required low emissions with lower levels of added ethanol.

The process of producing ethanol, transporting it, and the power that is produced from an ethanol fuel need to be considered when determining the overall efficiency of ethanol as a fuel additive. One can see there are detrimental effects on air quality, fuel energy or power, and cost.

Ethanol production emissions: There are significant air emissions to produce, transport, and use the ethanol. Ethanol is made from corn. There are a lot of steps from growing the corn to delivering it at the refinery. Think about the water that needs to be added to crops, water pumps run by fossil fuels that are used on a farm, and the fuel needed for the agricultural equipment. These are all sources of air emissions.

Creating ethanol for inclusion into gasoline requires more energy to make the ethanol than the energy the ethanol will produce. Adding up the energy costs of corn production and its conversion to ethanol, 131,000 BTU are needed to make 1 gallon of ethanol. One gallon of ethanol has an energy value of only 76,000 BTU. Put another way, about 70 percent more energy is required to produce ethanol than the energy that is in ethanol. Every time you make 1 gallon of ethanol for gasoline, there is a net energy loss of 54,000 BTU.

Then there is the fuel required to deliver the ethanol to refineries. I have seen rail cars of ethanol being delivered to our local refinery. The ethanol is then added to the gasoline the refinery produced.

Fuels are an energy source: The higher the fuel energy, the more efficient it is as a propulsion material. Fuels have different energy values that are measured by heat content of the fuel. Liquid fuels are measured by physical units such as gallons, and by heat content in BTUs. This becomes their energy content in BTU per gallon. Un-oxygenated gasoline (ethanol free) has a heat content of 125,000 BTU per gallon. Ethanol has a heat content of 76,000 BTU per gallon. A 10% ethanol gasoline therefore has a heat content of 120,000. As the amount of ethanol increases, the heat content of the fuel decreases and so does the power that is produced by it.

What happens with E10 gasoline? The power, and correspondingly, the gas mileage will decrease. There are studies that show this effect. That is only part of the issue with ethanol.

Cost: Since the creation of the domestic market for corn ethanol after the energy crisis of the 1970s, the federal government has nurtured and maintained the ethanol industry with a steady stream of subsidies. Federal subsidies include tax breaks for corn-based biofuels to dispense higher blends of ethanol such as E10 and the Renewable Fuel Standard mandate (RFS) for the use of corn ethanol. The RFS mandate requires oil and gas companies to blend increasing amounts of biofuels with gasoline each year through 2022, and corn ethanol comprises a majority (78 percent) of the mandate. Approximately $1 billion a year in current federal and state subsidies for ethanol production are costs to consumers.

So, you lose gas mileage, lose power, have added air emissions, and have a subsidized fuel additive that does no one any good, unless you are growing the corn.

Air Emission Regulations

Air pollution and cars were first linked in the early 1950's by a California researcher who determined that pollutants from traffic were to blame for the smoggy skies over Los Angeles. At the time, typical new cars were emitting nearly 13 grams per mile hydrocarbons (HC), 3.6 grams per mile nitrogen oxides (NOx), and 87 grams per mile carbon monoxide (CO). Since then, the U.S. Environmental Protection Agency (EPA) has set standards to bring down levels of these pollutants, and the auto industry has responded by developing new emission control technologies. These levels are currently around HC: 1.3, NOx: 0.04, CO 9; very significant reductions.

Over time, Congress authorized EPA to regulate emissions from other mobile sources of air pollution, such as heavy-duty trucks, agricultural and construction equipment, locomotives, lawn and garden equipment, and marine engines. These milestones in controlling emissions from mobile sources involve a variety of approaches including technological advances in engine design to higher quality fuels. This integrated approach to mobile source emission control also depends on extensive collaboration between EPA; vehicle, engine, and fuel manufacturers; state and local governments; transportation planners; and individual citizens.

The progress was made quickly and there was a lot of learning going on during the process. Here is a detailed summary of the progress of automobile emission controls and results. There have also been a lot of changes to non-road/ off-road engines, aircraft, locomotive, and marine engines that I am not going to mention other than the emission reductions for these engines is significantly high.

In 1970, Congress passes the first major law, (the Clean Air Act of 1970), requiring a 90 percent reduction in emissions from new automobiles by 1975. The EPA was established, and this new agency is given broad responsibility for regulating motor vehicle pollution. New cars must meet EPA emission standards for hydrocarbons (HC), carbon monoxide (CO), nitrogen oxide (NOx). The law also directs EPA to set health-based "National Ambient Air Quality Standards" for six air pollutants known as criteria pollutants: Ground-level ozone (O2), Particulate matter (PM), Carbon monoxide (CO), Nitrogen dioxide (NOx), Sulfur dioxide (SOx), and Lead.

In 1971, EPA begins testing the fuel economy of cars, trucks, and other vehicles, the first step towards informing consumers about the gas mileage of their vehicles. In 1972, exhaust gas recirculation valves are developed as automakers strive to meet NOx standards.

EPA creates new transportation controls in some of the nation's largest cities, including Los Angeles, Boston, Dallas, and others in 1973. Measures include exclusive bus lanes, bypass lanes for carpools and buses, parking garages and restrictions, and a mass transit incentive plan for California employers.

EPA releases a study confirming that lead from automobile exhaust poses a direct threat to public health. Later in 1973, EPA issues final regulations to gradually reducing lead in gasoline. You may remember the first unleaded gasoline pumps.

Congress passes the Energy Policy Conservation Act in 1975. This set the first fuel economy goals. The Corporate Average Fuel Economy (CAFE) program establishes a phase-in of more stringent fuel economy standards beginning with 1975 model vehicles.

The "first generation" catalytic converters were built, significantly reducing vehicle emissions. A new version of unleaded gasoline is also introduced because lead in gasoline may cause disintegration of catalytic converters. This results in dramatic reductions in ambient lead levels and alleviates many serious environmental and human health concerns associated with lead pollution.

In 1977 Congress amends the Clean Air Act which set a schedule for continued reductions in emissions from automobiles.

In 1981, new cars meet the amended Clean Air Act standards for the first time. Sophisticated three-way catalysts with on-board computers and oxygen sensors appear in most new cars, helping to optimize the efficiency of the catalytic converter.

Inspection and Maintenance (I/M) programs (1983) are established in areas with air pollution problems, requiring passenger vehicles to undergo periodic testing for malfunctioning emission control systems.

EPA sets stringent standards for emissions of NOx from heavy-duty engines and of PM from heavy-duty diesel-powered trucks and buses in 1985.

EPA issues final regulations to cut the amount of lead in gasoline by 90 percent starting January 1, 1986. The new standard is 0.10 grams per gallon.

For the first time, EPA sets fuel volatility limits aimed at reducing evaporative emissions in 1989.

In the 1990 Amendments to the Clean Air Act, EPA imposes limits on diesel fuel sulfur content to help buses and trucks meet the 1985 emission standards (which become effective in the early 1990s). These 1990 limits have now become the current requirement for ultra low surfur diesel of 15 ppm.

The Amendments require further reductions in HC, CO, NOx, and PM emissions. The Amendments also introduce lower tailpipe standards; more stringent emission testing procedures; expanded I/M programs; new vehicle technologies and clean fuels programs; and transportation management provisions. The Amendments also give EPA, for the first time, specific authority to regulate emissions from nonroad engines and vehicles.

The 1990 Amendments include fuel provisions that require oxygenated gasoline, which reduces emissions of CO, to be sold in areas that do not meet air quality standards for the pollutant. In addition, the Amendments require reformulated gasoline to be sold in the nine worst areas that do not meet the minimum national air quality standards for ozone. Reformulated gasoline (RFG) is gasoline blended to burn more cleanly than conventional gasoline and to reduce smog-forming and toxic pollutants. The first phase of the RFG program began in 1995 and the second (current) phase began in 2000.

In the following year, EPA establishes lower tailpipe standards for HC and NOx as required by the 1990 Clean Air Act to take effect beginning with 1994 models. EPA then established standards setting emission limits for CO at cold temperatures for the first time. Oxygenated gasoline is introduced in cities with high CO levels.

The Partnership for a New Generation of Vehicles was established in 1993 to develop new automotive technology to help reduce air pollution by tripling the fuel economy of typical family sedans without sacrificing safety, performance, and affordable cost. EPA then issued final regulations requiring that gasoline sold in certain areas be reformulated to reduce vehicle emissions of toxic and ozone-forming compounds.

In 1996, EPA completes its 25-year mission to completely remove lead from gasoline. Lead is banned from gasoline as of January 1, 1996.

In 1999, EPA finalizes more protective tailpipe emissions standards, marking the first time that SUVs and other light-duty trucks are subject to the same national pollution standards as cars. At the same time, EPA finalizes lower standards for sulfur in gasoline to ensure the effectiveness of low emission-control technology and reduce air pollution.

In 2000, EPA develops a comprehensive national control program to regulate the heavy-duty vehicle and its fuel as a single system. These new standards apply to model year 2007 heavy-duty on-road engines and vehicles.

In 2001, EPA issues final regulations to control emissions of air toxics from mobile sources. In addition to identifying 21 mobile source air toxics, this rule sets new gasoline toxic emission performance standards.

EPA announces the Clean School Bus USA Program in 2004. It encourages policies and practices to eliminate unnecessary public school bus idling; upgrades buses that will remain in the fleet with better emission-control technologies and/or fueling them with cleaner fuels; and replaces the oldest buses in the fleet with new, less-polluting buses.

EPA finalizes new emission standards for highway motorcycles to reduce the combined HC and NOx emissions in the exhaust by 50 percent as well as air toxics.

In 2006, EPA adjusts the test methods used for calculating fuel economy estimates. These new methods bring the miles per gallon estimates closer to consumers' actual fuel economy, require fuel economy labels on certain heavier vehicles up to 10,000 pounds gross vehicle weight, such as larger SUVs and vans, and convey fuel economy information to the public more effectively by changing the design and content of the window sticker.

In 2007, EPA issues final regulations to reduce air toxics from mobile sources. The final standards significantly lower emissions of benzene and the other air toxics in three ways: 1. By lowering benzene content in gasoline; 2. By reducing exhaust emissions from passenger vehicles operated at cold temperatures (under 75 degrees); and 3. By reducing emissions that evaporate from, and permeate through, portable fuel containers.

EPA establishes a national Renewable Fuel Standard Program to encourage the blending of renewable fuels into our nation's motor vehicle fuel. Establishment of an RFS Program is required by the Energy Policy Act of 2005 to move the United States toward greater energy independence and security.

EPA granted a waiver of Clean Air Act preemption to California for its greenhouse gas emission standards for motor vehicles beginning with the 2009 model year because of California’s severe pollution problems.

In addition, after a thorough examination of the science and careful consideration of public comments, EPA finds that the current and projected concentrations of the six key well-mixed greenhouse gases in the atmosphere threaten the public health and welfare of current and future generations. As a result of this Endangerment Finding, greenhouse gases that lead to climate change can be regulated under the Clean Air Act.

In 2010, EPA and the Department of Transportation’s National Highway Traffic Safety Administration (NHTSA) finalize a joint rule to establish a national program consisting of new standards for model year 2012 through 2016 light-duty vehicles to reduce greenhouse gas emissions and improve fuel economy. These are EPA’s first national greenhouse gas (GHG) emissions standards under the Clean Air Act.

EPA grants a partial waiver to allow E15 (15 percent ethanol) to be used in model year 2007 and newer light-duty vehicles if health-effects testing requirements and other conditions can be satisfied. Refiners add ethanol to gasoline to meet the renewable fuel requirements of the 2007 Energy Independence and Security Act.

EPA extends the waiver to allow E15 to be used in model year 2001 through 2006 light-duty vehicles if health-effects testing requirements and other conditions can be satisfied.

EPA and NHTSA unveil the most dramatic overhaul to fuel economy labels since they were introduced. Starting with the 2013 model year, the redesigned label provides the public with more comprehensive information on vehicles' fuel economy, energy use, fuel costs, and environmental impacts.

In 2012, EPA and NHTSA extend the national program to further reduce greenhouse gas emissions and improve fuel economy for passenger cars, light-duty trucks, and medium-duty passenger vehicles through model year 2017 through 2025.

EPA and NHTSA extend the National Program of harmonized greenhouse gas and fuel economy standards for light duty vehicles to model year 2017 through 2025 passenger vehicles. Over the lifetime of the MY 2017-2025 standards, this program is projected to save approximately 4 billion barrels of oil and 2 billion metric tons of GHG emissions, with net benefits up to $451 billion.

The EPA finalized Tier 3 Standards for gasoline in 2014 for passenger cars, light-duty trucks, medium-duty passenger vehicles, and some heavy-duty vehicles. Starting in 2017, Tier 3 sets new vehicle emissions standards and lowers the sulfur content of gasoline, considering the vehicle and its fuel as an integrated system.